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EXAMINER	
GIROUX, GEORGE	

ART UNIT	PAPER NUMBER
2183	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary

Application No.

10/511,512

Applicant(s)

LEIJTEN, JEROEN ANTON
JOHAN

Examiner

George D. Giroux

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 August 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 October 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. This Office Action is in response to applicant's communication filed 22 August 2007, in response to the Office Action mailed 22 May 2007. The applicant's remarks and amendments to the claims and specification were considered, with the results that follow.
2. The objections to the specification, and to claim 2, have been withdrawn due to the amendment filed 22 August 2007.
3. Claims 4-7 have been added, claims 1-7 have been considered, with the results that follow.

Continued Examination Under 37 CFR 1.114

4. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 22 August 2007 has been entered.

Response to Arguments

5. Applicant's arguments with respect to claims 1 and 3 have been considered but are moot in view of the new ground(s) of rejection.

Slavenburg (US 6,122,722) teaches the use of a switching matrix within a VLIW processor, which controls the connection between the register file outputs and the inputs of the functional units, while Martonosi (US 6,745,336) teaches the use of latches to hold operands from the register file being sent to the functional units.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1, 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Slavenburg (US 6,122,722) in view of Martonosi (US 6,745,336).

As per claim 1, Slavenburg teaches a multi-issue processor comprising a register file as **[the register file 403 of a VLIW processor with multiple issue slots, ISSUE 1-3 (figure 3)]**, a plurality of issue slots each comprising a plurality of functional units as **[issue slots 1-3 (figure 3) where the processor has less issue slots than there are functional units in the machine. As an example, for a machine with 7 functional units, 3 issue slots may suffice. In general, the number of issue slots for a given number and type of functional units is a tradeoff between average performance**

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and cost (column 3, lines 49-56)], an input routing network as [switching matrix 401 (figure 3)] that provides multiple data path outputs for a single data path input, the input routing network receiving data from the register file on the single data path input via a single data input path and providing data from the register file to functional units of the plurality of functional units, the data provided on the multiple data path outputs via multiple data output paths as [switching matrix 401, controlled by the input switch control 902, determines which read port (input path) to connect to the inputs of which functional unit (output paths) (column 4, lines 1-3 and figure 3)].

Slavenburg does not teach a plurality of holdable registers that hold duplicate data from the register file, and wherein in a first set of the plurality of issue slots the holdable registers store data on the multiple data output paths of the first set and in a second set of the plurality of issue slots the holdable registers store data on the single data input path corresponding to the input routing networks of the second set.

Martonosi teaches a plurality of holdable registers that hold duplicate data from the register file as **[input latches A (30 and 32) and B (34 and 36) (figure 1)]**, wherein in a first set of the plurality of issue slots the holdable registers store data on the multiple data output paths of the first set and in a second set of the plurality of issue slots the holdable registers store data on the single data input path corresponding to the input routing networks of the second set as **[input latches 30, 32, 34 and 36, for input operands A and B sit at the inputs to the functional unit 40 holding the operands from the registers (received via lines 60 and 62) (column 4, lines 30-38 and figure 1)]** wherein the switching matrix taught by Slavenburg (described above) sits at the

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inputs of the functional units, and putting the holdable registers before or after the switching matrix is purely a matter of design choice.

Slavenburg and Martonosi are analogous art, as they are within the same field of endeavor, namely instruction processing.

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to combine the VLIW processor with a switching matrix controlling the inputs of the functional units, taught by Slavenburg, with the input latches taught by Martonosi.

The motivation for doing so, as provided by Martonosi, would have been **[to reduce the power used in the microprocessor by detecting and disabling a predetermined number of bits that are not required for execution in the functional unit, using the operands within the input latches (column 4, lines 39-54)]**.

As per claim 3, Slavenburg teaches wherein the input routing network of each of the plurality of issue slots has a plurality of data path inputs as **[switching matrix 401, controlled by the input switch control 902, determines which read port (input paths) (such as R_{1a} - R_{3b}) to connect to the inputs of which functional unit (output paths) (column 4, lines 1-3 and figure 3)]**.

Slavenburg does not teach in the second set of issues lots holdable registers of the plurality of holdable registers are located between each of the inputs of the input routing network and the register file, however.

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Martonosi teaches in the second set of issues lots holdable registers of the plurality of holdable registers are located between each of the inputs of the input routing network and the register file as **[input latches 30, 32, 34 and 36, for input operands A and B sit at the inputs to the functional unit 40 holding the operands from the registers (received via lines 60 and 62) (column 4, lines 30-38 and figure 1)]** wherein the switching matrix taught by Slavenburg (described above) sits at the inputs of the functional units, and putting the holdable registers before or after the switching matrix is purely a matter of design choice.

Slavenburg and Martonosi are analogous art, as they are within the same field of endeavor, namely instruction processing.

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to combine the VLIW processor with a switching matrix controlling the inputs of the functional units, taught by Slavenburg, with the input latches taught by Martonosi.

The motivation for doing so, as provided by Martonosi, would have been **[to reduce the power used in the microprocessor by detecting and disabling a predetermined number of bits that are not required for execution in the functional unit, using the operands within the input latches (column 4, lines 39-54)].**

As per claim 4, Martonosi teaches wherein, in the first set of issue slots, holdable registers are located between the input routing networks and each of the plurality of function units as **[input latches 30, 32, 34 and 36, for input operands A and B sit at**

the inputs to the functional unit 40 holding the operands from the registers (received via lines 60 and 62) (column 4, lines 30-38 and figure 1)].

8. Claims 2 and 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Slavenburg (US 6,122,722) in view of Martonosi (US 6,745,336), as applied to claim 1 above, and further in view of Fisher (US 6,026,479).

As per claim 2, Slavenburg teaches the multi-issue processor of claim 1, in view of Martonosi, as described above.

Slavenburg does not teach “a first instruction set accessing at least the first set of issue slots; and a second instruction set accessing the second set of issue slots”, however.

Fisher teaches “a first instruction set accessing at least the first set of issue slots; and a second instruction set accessing the second set of issue slots” as [**“A CPU having a cluster VLIW architecture...which operates in both a high instruction level parallelism (ILP) mode and a low ILP mode. In high ILP mode, the CPU executes wide instruction words using all operational clusters of the CPU and all of a main instruction cache and main data cache of the CPU are accessible to a high ILP task. The CPU also includes a mini-instruction cache, a mini-instruction register and a mini-data cache which are inactive during high ILP mode. An instruction level controller in the CPU receives a low ILP signal, such as an interrupt or function call to a low ILP routine, and switches to low ILP mode. In low ILP mode, the main instruction cache and main data cache are deactivated to**

preserve their contents. At the same time, a predetermined cluster remains active while the remaining clusters are also deactivated. The low ILP task executes instructions from the mini-instruction cache which are input to the predetermined cluster through the mini-instruction register. The mini-data cache stores operands for the low ILP task”(abstract, lines 1-19)].

Slavenburg and Fisher are analogous art, as they are within the same field of endeavor, namely VLIW processing.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to combine the VLIW processor with a switching matrix controlling the inputs of the functional units, taught by Slavenburg, with the multiple instruction sets of Fisher.

The motivation for doing so is provided by Fisher as [**“the separate mini-instruction cache and mini-data cache along with the use of only the predetermined cluster minimizes the pollution of the main instruction and data caches, as well as pollution of register files in the deactivated clusters, with regard to a task executing in high ILP mode”(abstract, lines 20-24)].**

As per claim 5, Slavenburg teaches the multi-issue processor of claim 1, in view of Martonosi, as described above.

Slavenburg does not teach wherein the first set of issue slots are accessed by a first set of instructions for a VLIW processor and the second set of issue slots are accessed by a second set of instructions that are used by an interrupt routine, however.

Fisher teaches wherein the first set of issue slots are accessed by a first set of instructions for a VLIW processor and the second set of issue slots are accessed by a second set of instructions that are used by an interrupt routine as **[“A CPU having a cluster VLIW architecture...which operates in both a high instruction level parallelism (ILP) mode and a low ILP mode. In high ILP mode, the CPU executes wide instruction words using all operational clusters of the CPU and all of a main instruction cache and main data cache of the CPU are accessible to a high ILP task. The CPU also includes a mini-instruction cache, a mini-instruction register and a mini-data cache which are inactive during high ILP mode. An instruction level controller in the CPU receives a low ILP signal, such as an interrupt or function call to a low ILP routine, and switches to low ILP mode. In low ILP mode, the main instruction cache and main data cache are deactivated to preserve their contents. At the same time, a predetermined cluster remains active while the remaining clusters are also deactivated. The low ILP task executes instructions from the mini-instruction cache which are input to the predetermined cluster through the mini-instruction register. The mini-data cache stores operands for the low ILP task”](abstract, lines 1-19)].**

Slavenburg and Fisher are analogous art, as they are within the same field of endeavor, namely VLIW processing.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to combine the VLIW processor with a switching matrix controlling the

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inputs of the functional units, taught by Slavenburg, with the multiple instruction sets of Fisher.

The motivation for doing so is provided by Fisher as [**“the separate mini-instruction cache and mini-data cache along with the use of only the predetermined cluster minimizes the pollution of the main instruction and data caches, as well as pollution of register files in the deactivated clusters, with regard to a task executing in high ILP mode”**](abstract, lines 20-24)].

As per claim 6, Fisher teaches wherein the second set of instructions has fewer instructions than the first set of instructions as [**An embodiment of a method for reducing cache pollution in a CPU, according to the present invention, includes providing a main instruction cache configured to store VLIW instructions, wherein each VLIW instruction is further comprised of a plurality of c-instructions, providing a plurality of operational clusters, wherein each one of the plurality of operational clusters is configured to receive one of the plurality of c-instructions of each VLIW instruction in the main instruction cache, and executing a high ILP task by loading VLIW instructions from the main instruction cache into a main instruction register for output to the plurality of clusters. The method includes receiving a low ILP signal and, responsive thereto, deactivating the main instruction cache and main instruction register, deactivating the plurality of operational clusters, except for a predetermined one of the operational clusters, activating a mini-instruction cache and a mini-instruction**

register, and serially executing a low ILP task by serially loading c-instructions from the mini-instruction cache into the mini-instruction cache for output to the predetermined one of the operational clusters (column 4, lines 16-34)].

As per claim 7, Slavenburg teaches the multi-issue processor of claim 1, in view of Martonosi, as described above.

Slavenburg does not teach wherein the first set of issue slots has more issue slots than the second set of issue slots, however.

Fisher teaches wherein the first set of issue slots has more issue slots than the second set of issue slots as [**"The CPU also includes a mini-instruction cache, a mini-instruction register and a mini-data cache which are inactive during high ILP mode. An instruction level controller in the CPU receives a low ILP signal, such as an interrupt or function call to a low ILP routine, and switches to low ILP mode. In low ILP mode, the main instruction cache and main data cache are deactivated to preserve their contents. At the same time, a predetermined cluster remains active while the remaining clusters are also deactivated. The low ILP task executes instructions from the mini-instruction cache which are input to the predetermined cluster through the mini-instruction register. The mini-data cache stores operands for the low ILP task"**](abstract, lines 6-19) wherein deactivating some clusters means the cluster running the low ILP tasks (the second set of issue slots) is smaller than the first].

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Slavenburg and Fisher are analogous art, as they are within the same field of endeavor, namely VLIW processing.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to combine the VLIW processor with a switching matrix controlling the inputs of the functional units, taught by Slavenburg, with the multiple instruction sets of Fisher.

The motivation for doing so is provided by Fisher as **["the separate mini-instruction cache and mini-data cache along with the use of only the predetermined cluster minimizes the pollution of the main instruction and data caches, as well as pollution of register files in the deactivated clusters, with regard to a task executing in high ILP mode"]**(abstract, lines 20-24)].

Conclusion

9. The following is a summary of the treatment and status of all claims in the application as recommended by **M.P.E.P. 707.07(i)**: claims 4-7 have been added, claims 1-7 are rejected.

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Tremblay (WO 00/33178) – teaches a VLIW processor which partitions the register file into local and global registers, where local registers are associated

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with specific functional units while global registers can be read from- and written to by each of the functional units.

11. The examiner requests, in response to this Office action, support be shown for language added to any original claims on amendment and any new claims. That is, indicate support for newly added claim language by specifically pointing to page(s) and line number(s) in the specification and/or drawing figure(s). This will assist the examiner in prosecuting the application.

12. When responding to this office action, Applicant is advised to clearly point out the patentable novelty which he or she thinks the claims present, in view of the state of the art disclosed by the references cited or the objections made. He or she must also show how the amendments avoid such references or objections See 37 CFR 1.111(c).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to George D. Giroux whose telephone number is 571-272-9769. The examiner can normally be reached on Monday through Friday, 8:30am - 6:00pm E.S.T.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie P. Chan can be reached on 571-272-4162. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

9-15-07

George Giroux
Examiner
Art Unit 2183


RICHARD L. ELLIS
PRIMARY EXAMINER